



Science Requirements

Ken Seidelmann
Science Team Chairman
USNO
804-243-5567
pks6n@virginia.edu



FAME Science Team



- **Dr. John Bahcall, Princeton**
- **Dr. Charles Beichman, Caltech**
- **Dr. Alan Boss, Carnegie Inst. Washington**
- **Dr. Christian DeVegt, U. Hamburg**
- **Dr. George Gatewood, U. Pittsburgh**
- **Dr. Marvin Germain, USNO**
- **Dr. Andrew Gould, Ohio State**
- **Dr. Thomas P. Greene, NASA Ames**
- **Dr. Scott Horner, Lockheed Martin**
- **Dr. John Huchra, CfA**
- **Dr. William H. Jefferys, U. Texas**
- **Dr. Kenneth Johnston, USNO**
- **Dr. David Monet, USNO**
- **Dr. Marc Murison, USNO**
- **Dr. James Phillips, SAO**
- **Dr. Robert Reasenberg, SAO**
- **Dr. Allan Sandage, Carnegie Obs.**
- **Dr. P. Kenneth Seidelmann, U. VA**
- **Dr. Mike Shao, JPL**
- **Dr. Irwin I. Shapiro, CfA**
- **Mr. Sean Urban, USNO**
- **Dr. William Van Altena, Yale**
- **Dr. Donald York, U. Chicago**



Baseline Science Requirements



Astrometry		
Position	Parallax	Proper Motion
5-9 mag	50 μ as, 50 μ as	70 μ as/Year
15 mag	500 μ as, 500 μ as	500 μ as/Year
40 Million Stars		

Photometry - Sloan r' and I'		
	Single Obs	Mission
9 mag	5 mmag	1 mmag
15 mag	100 mmag	10 mmag

Photometry - Astrometric Filter		
	Single Obs	Mission
9 mag	2 mmag	1 mmag
12 mag	8 mmag	2 mmag



Baseline Science Investigations



- **The FAME Catalog Will Provide the Basis for a Variety of Scientific Investigations, Which Can Be Summarized As Follows:**
 - **Determine Distances to Standard Candles Such As Cepheids and RR Lyrae Stars, and Calibrate Their Absolute Magnitudes to an Accuracy of 0.02 mag**
 - **Calibrate Stellar Masses and Luminosities in the Solar Neighborhood for a Variety of Applications in Stellar Astrophysics**
 - **Provide a Definitive Determination of the Frequency of Brown Dwarf Companions in the Range of 10 to 80 Jupiter Masses**
 - **Determine Orbits for Brown Dwarfs and Giant Planets Down to 8 Jupiter Masses for a Sample of 20,000 Stars Within 100 pc**
 - **Determine Memberships, Ages and Kinematics of Individual Stars in Star-Forming Regions Out to Distances of at Least 1 kpc**
 - **Provide Astrometric and Photometric Results for 40 Million Stars for Applications in Galactic Structure and Evolution**



Astrometric Positions



- Baseline and Minimum Performance Requirements for the 5-Year Mission:**

	V (mag)	Requirement (μ as)	Minimum (μ as)
Standard candles (residuals):	5-8	50	
	9	50	200
	12	125	400
	15	500	1000
Solar-Neighborhood Stars (residuals):	5-8	50	
	9	50	200
	15	500	2000
Brown Dwarfs (residuals):	5-8	50	
	9	50	200
	15	500	2000
Star forming regions (residuals):	5-8	50	
	9	50	200
	12	125	500
	15	500	1000
Reference Frame (positions):	5-8	50	
	9	50	200
	15	500	1000
Stellar Astrophysics (residuals):			
White Dwarfs:	12	125	500
	15	500	1000
Planetary Nebulae:	12	125	500
	15	500	1000
Subdwarf O/B Stars:	12	125	500
	15	500	1000
HB Stars:	12	125	500
	15	500	1000
Galactic Structure (residuals):	5-8	50	
	9	50	200
	12	125	500
	15	500	2000
Relativity (positions):	9	1000	2000
Solar System (positions):	9	2000	10000



Astrometric Proper Motions



- Baseline and Minimum Performance Requirements for the 5-Year Mission**

	V (mag)	Requirement $\mu\text{as/yr}$	Minimum $\mu\text{as/yr}$
Standard candles:	5-8	70	
	9	70	200
	12	125	400
	15	500	1000
Solar-Neighborhood Stars:	5-8	70	
	9	70	200
	15	500	2000
Brown Dwarfs:	5-8	70	
	9	70	200
	15	500	2000
Star forming regions:	5-8	70	
	9	70	200
	12	125	500
	15	500	1000
Reference Frame:	5-8	70	
	9	70	200
	15	500	1000
Stellar Astrophysics:			
	White Dwarfs:		
	12	125	500
	15	500	1000
	Planetary Nebulae:		
	12	125	500
	15	500	1000
	Subdwarf O/B Stars:		
	12	125	500
	15	500	1000
	HB Stars:		
	12	125	500
	15	500	1000
Galactic Structure:	5-8	70	
	9	70	200
	12	125	500
	15	500	2000
Relativity:			
Solar System:			



Astrometric Parallaxes



- Baseline and Minimum Performance Requirements for the 5-Year Mission**

	V (mag)	Requirement (μ as)	Floor (μ as)
Standard candles:	5-8	50	
	9	50	200
	12	125	400
	15	500	1000
Solar-Neighborhood Stars:	5-8	50	
	9	50	200
	15	500	2000
Brown Dwarfs:	5-8	50	
	9	50	200
	15	500	2000
Star forming regions:	5-8	50	
	9	50	200
	12	125	500
	15	500	1000
Reference Frame:	5-8	50	
	9	50	200
	15	500	1000
Stellar Astrophysics:			
White Dwarfs:	12	125	500
	15	400	2000
Planetary Nebulae:	12	125	500
	15	500	1000
Subdwarf O/B Stars:	12	125	200
	15	500	1000
HB Stars:	12	125	300
	15	500	1000
Galactic Structure:	5-8	50	
	9	50	200
	12	125	500
	15	500	2000
Relativity:			
Solar System:			



Photometry Requirements (1 of 2)



- Baseline and Minimum Photometric Performance Requirements for the 5-Year Mission**

	Filter	V (mag)	Requirement (mmag)	Floor (mmag)
Standard candles (non-variable stars, mission):	w	12	10	
	SDSS	5-9	1	
		12	2	10
		15	10	20
Solar Neighborhood stars (per observation):	w	10	3	20
	w	5-9	2	
		15	10	
Brown Dwarfs (per observation):	w	5-9	3	
		12	12	20
Star forming region (per observation) (mission)	w	5-9	2	
		12	8	20
	SDSS	5-9	1	
		12	2	10
		15	10	20
Reference Frame:	w	5-9	10	
Photometry: (per observation) (mission)	SDSS	5-9	2	
		5-9	1	
		15	10	20



Photometry Requirements (2 of 2)



- Baseline and Minimum Photometric Performance Requirements for the 5-Year Mission**

	Filter	V (mag)	Requirement (mmag)	Floor (mmag)
Stellar Astrophysics:				
Solar-type stars (per observation):	w	5-9	2	20
		12	8	
Radial Pulsators (per observation):	w	5-9	2	30
		12	8	
Non-radial Pulsators (per observation):	w	5-9	3	10
		12	10	
Non-Radial Pulsators (mission):	w	9	1	5
		12	2	10
		15	8	20
Interstellar matter (mission):		12	2	20
Galactic Structure (mission):	w	5-9	1	10
		12	2	
		15	8	
	SDSS	5-9	1	
		12	2	
		15	10	20
Relativity:				
Solar System:				



Summary



- **Designing for Observational Baseline Requirements**
- **Observations Provide the Data for Many Scientific Investigations**
- **Minimum Observational Accuracies Would Still Support Many Scientific Investigations**